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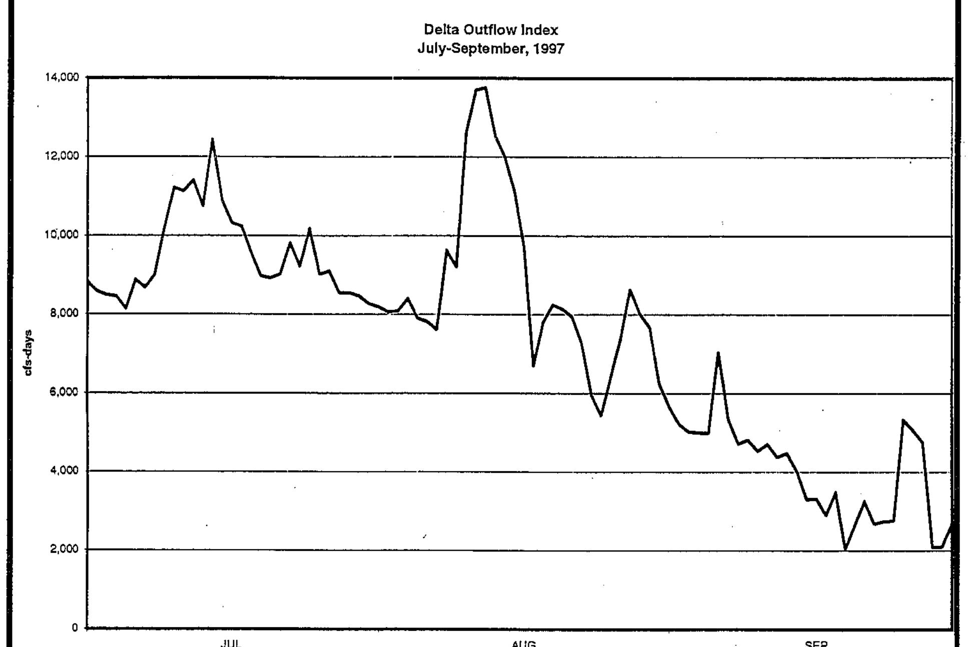
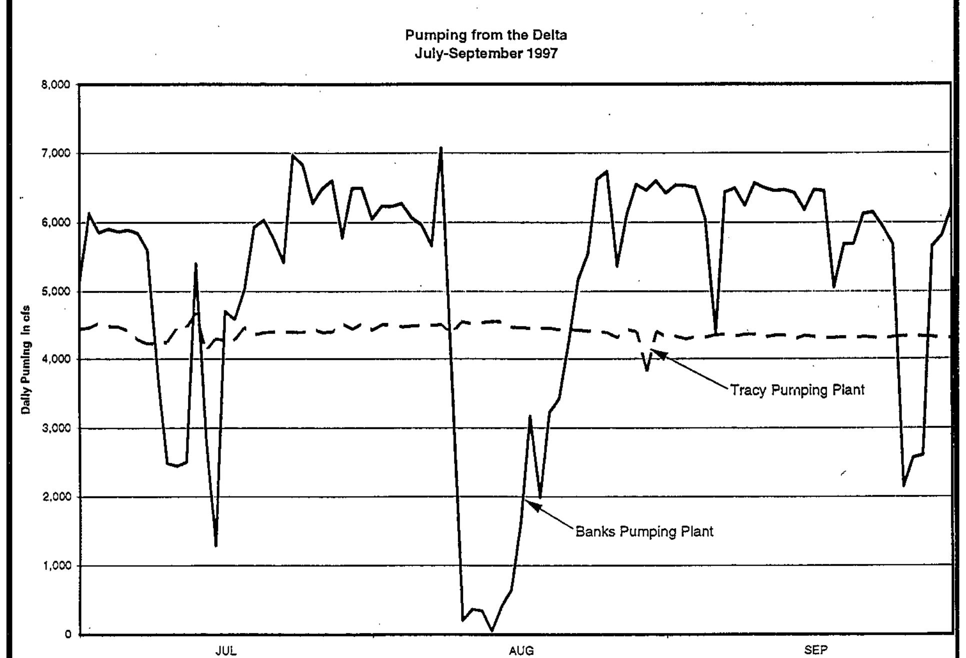
Delta Outflow

Chris Enright, DWR

Between July 1 and September 30, the average Delta Outflow Index was 7,432 cfs. The largest outflow was on August 11, at 13,758 cfs, and the smallest was on September 26, at 2,096 cfs. Combined SWP/CVP pumping averaged about 9,750 cfs during this period. SWP pumping was severely curtailed from August 9 through August 15 due to emergency work to repair aqueduct lining in pools 10 and 12. The SWP pumped at a rate of 900 cfs per day for the CVP wildlife refuge from July 23 through August 3. The SWP also pumped CVP Cross Valley water at 1,260 cfs per day from August 4 through August 8. The SWP started pumping 1997 CVP spring actions makeup water on September 17, at a rate of 1,500 cfs during on-peak hours and continued at this rate through October 9.





First Annual IEP Monitoring Survey of the Chinese Mitten Crab in the Delta and Suisun Marsh

Tanya Veldhuizen, DFG

The Chinese mitten crab, *Eriocheir sinensis,* native to coastal rivers and estuaries of China and Korea along the Yellow Sea (Panning 1938), was first discovered in South San Francisco Bay in 1992 and quickly spread throughout the estuary during the next several years. Mitten crabs were first collected in San Pablo Bay in the fall of 1994, in Suisun Marsh in February 1996, and in the Sacramento-San Joaquin Delta in August 1996 (Hieb 1997). The current known distribution of the Chinese mitten crab in the delta extends north up the Sacramento River to the Port of Sacramento, east to Stockton (Fourteen-mile Slough), and south to Fabian and Bell Canal. The crab is also distributed throughout Suisun Marsh. We expect the known distribution to expand this fall as emigrating adult crabs continue to be incidentally caught by fishermen.

This summer was a pilot year for implementing an annual monitoring program for juvenile mitten crabs. The 45 adult crabs collected last fall and winter indicated the population in the northern estuary was large enough to be detected by monitoring. Because the juvenile crab's diet is comprised mainly of vegetation, capturing them with baited traps was not feasible. Instead, juvenile crabs were excavated from the burrows they dig for protection from predators and desiccation during low tide (Panning 1938).

After surveying the delta and Suisun Marsh for potential sites in late June and early July, 15 monitoring stations were selected based on several criteria: sites had to be tidally influenced, contain adequate expanses of unrocked bank exposed during low tide, and be accessible by vehicle. We attempted to select stations to achieve an even distribution throughout the delta and marsh, but due to large expanses of riprapped bank or inaccessibility, portions of the delta may be under-represented.

We are monitoring 4 marsh stations and 11 delta stations. In the delta, 8 are core stations and 3 are peripheral stations. Core stations are sampled twice a year separated by 4 weeks. Peripheral stations are sampled once a year, and represent the upstream limit of where juvenile mitten crabs can be expected to burrow.

Each station was surveyed during low tide when the bank was exposed. We searched for mitten crabs along a 5-meter transect paralleling the bank and extending from the water line to the high tide line or to the top of the bank. The transect height was measured at 1-meter intervals, and the average height was used to determine the total area of the transect. For core stations, the second transect was placed within 0.25 mile of the first transect, preferably adjacent to the original. Transect searches involved excavating all cavities, such as burrows and rotted root tunnels, and examining all debris, driftwood, rootwads, and ponded water for mitten crabs.

We measured carapace length and width at the widest point of each crab. Crabs larger than 9 millimeters were sexed, and all were returned to the same location where captured. We also recorded vegetation and soil types, bank profile, water salinity and temperature, and tidal phase.

Sampling began in late July and continued through early September. Average density was highest at the Suisun Marsh stations (Figure 1) — Denverton Slough had the highest (3.07 crabs/m^2) and Montezuma Slough had the lowest (0.55 crabs/m^2). During the second survey, density increased at the Montezuma and Denverton Slough stations and decreased at the Suisun and Hill Slough stations. Mean carapace width was 15.3 millimeters for both surveys (n=25, survey 1; n=36, survey 2). Salinity was 4.4-7.2 l and was highest at Denverton Slough on both surveys.

Crabs were found at only 4 of the 8 core stations in the delta (Figure 1). Average density was relatively low, ranging from 0.31 crabs/m^2 in Middle River near the railroad tracks on Jones Tract to 0.13 crabs/m^2 in Fabian and Bell Canal at Tracy Oasis Marina. Mean size was also 15.3 mm carapace width (n=11); all crabs were collected from fresh water. Density at all 4 of these core stations declined to zero on the second survey. No crabs were found at the peripheral stations.

Juvenile crab density in the delta and Suisun Marsh is significantly less than in South San Francisco Bay sloughs. Average density for 1997 in South Bay sloughs was 3.38 to 6.31 crabs/m^2 in July and 5.02 to 15.87 crabs/m^2 in August (Diana Theriault, UC-Berkeley, personal communication). Previously, a maximum density of 30 crabs/m^2 was reported (Halat 1997).

Both the SWP and CVP pumping plants collected the first juvenile mitten crabs this summer. Skinner Fish Facility caught one crab of 29 mm carapace width in August. Tracy Fish Facility captured juvenile crabs in the holding tanks beginning in late June. Mean size of age-0 juveniles was 15.0 mm carapace width in June (n=1), 17.6 mm in July (n=21), 23.2 mm in

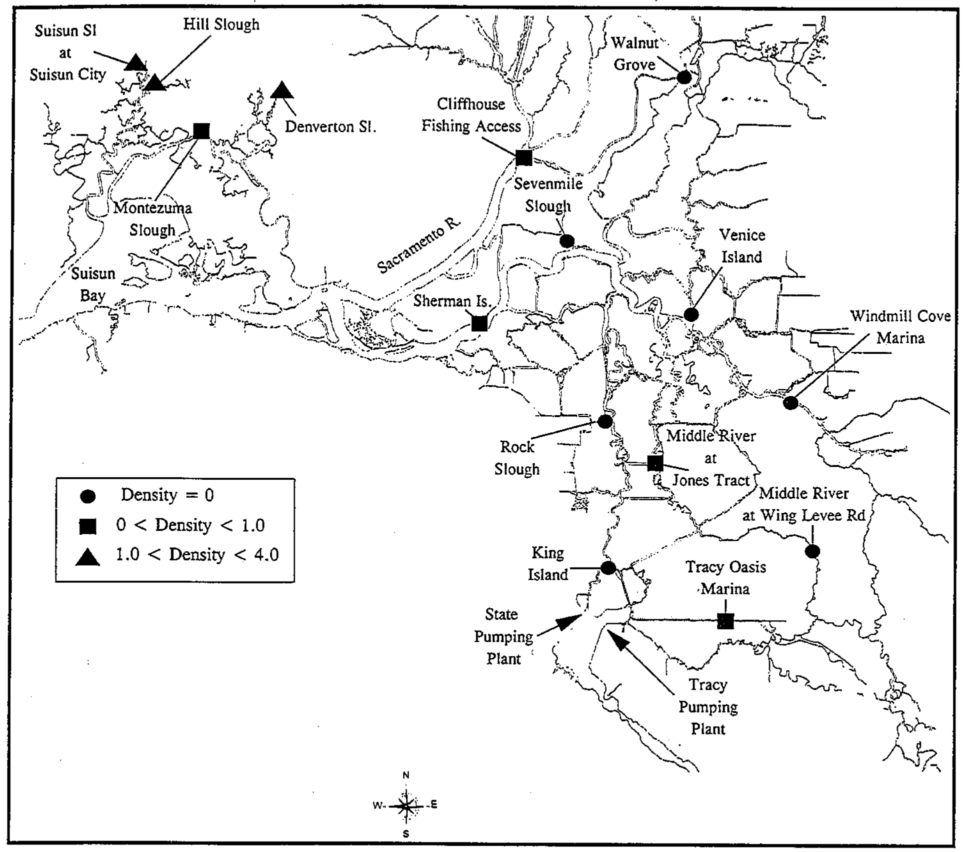


Figure 1
AVERAGE DENSITY OF JUVENILE CHINESE MITTEN CRABS, SUMMER 1997

August (n=13), and 31.0 mm in September (n=7). Additional crabs, which were determined to be age-1 or age-2, were collected in July, August and September. These totals represent only a small fraction of crabs located at the pumps. Only crabs caught during the periodic 10-minute counts were saved; others were salvaged with the fish without being counted. Also, fish facility crews reported finding crabs in the floating debris caught against the screens and among the louver structures.

The Interagency Program will continue to monitor juvenile mitten crabs. Sampling will occur in July and August, the peak migration period of juvenile crabs to brackish and freshwater rearing areas. We plan to add several more stations in the delta, including additional core stations in the central and western delta and a peripheral station in the southeastern delta.

Acknowledgments

I thank Anna Holmes and Jennifer Osmondson (DFG) for their assistance in field collections and developing sampling procedures; Kathy Hieb for the opportunity to collaborate on the design and implementation of a biological study; USBR personnel at Tracy Fish Collection Facility and DFG personnel at the Skinner Fish Facility for crab collections; Kathleen Halat of Wetlands Research Associates and Diana Theriault of UC-Berkeley for guidance on sampling protocol and sharing data; Dave Feliz of Grizzly Island Wildlife Area and Bay-Delta Division personnel who provided valuable advice on locations of potential monitoring sites; and Paul Raquel, Tracy Oasis Marina, and Windmill Cove for access to their property. This work is part of the Green and Mitten Crab Studies, funded and supported by the Interagency Ecological Program.

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Annual Interagency Program Workshop

The 1998 workshop will be February 25-27, at Asilomar Conference Center in Pacific Grove. As in years past, the workshop will provide information on a number of projects via oral and poster presentations and panel discussions. The Bay-Delta Modeling Forum will hold its spring meeting and workshop February 24-25 at Asilomar, so you can attend all or part of both workshops.

The planning committee is now formulating an agenda for the IEP workshop. The agenda will go out with the registration forms in December. Please contact Chuck Armor (carmor@delta.dfg.ca.gov) or Zach Hymanson (zachary@water.ca.gov) for information.

Late-Summer 1997 Dissolved Oxygen Conditions in the Stockton Ship Channel

Steve Hayes, DWR

Dissolved oxygen concentrations in the Stockton Ship Channel are closely monitored during the late summer and early fall, because levels can drop below 5.0 mg/L in the eastern channel due to low inflow, warm temperature, high biochemical oxygen demand, reduced tidal circulation, and intermittent reverse flows in the San Joaquin River past Stockton. Low dissolved oxygen levels can cause physiological stress to fish and block upstream migration of salmon.

The first of eight dissolved oxygen runs for this year was August 4, and monitoring is scheduled to continue through November. During each run, 14 sites are sampled from Prisoners Point (site 1) in the central delta to the turning basin (site 14) (Figure 1). Dissolved oxygen and water temperature data are collected for each site at the top and bottom of the water column during ebb slack tide using continuous monitoring instrumentation made available by USBR.

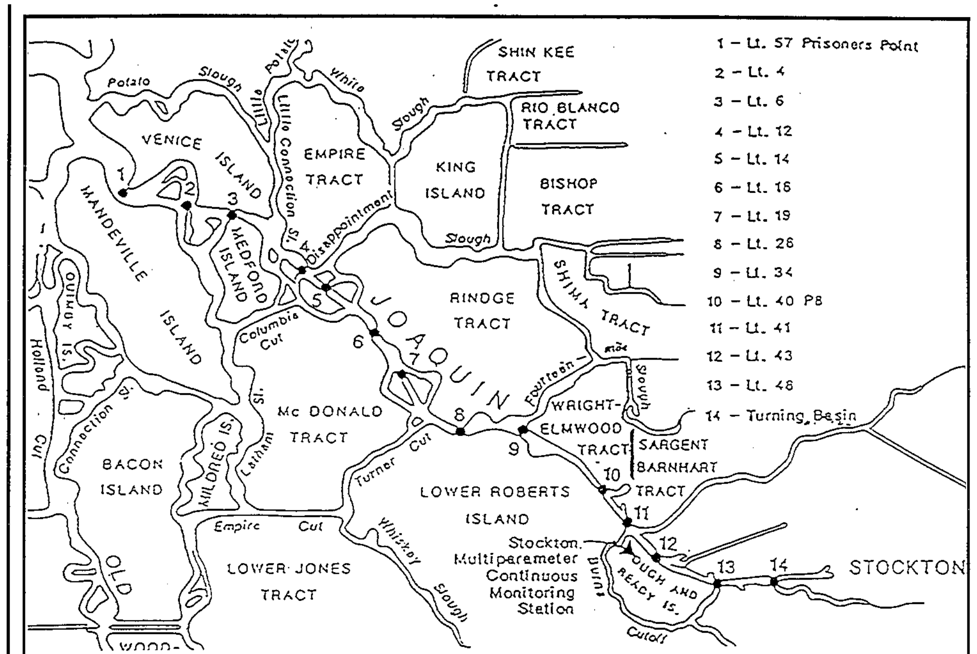

Figure 1
DISSOLVED OXYGEN SAMPLING SITES

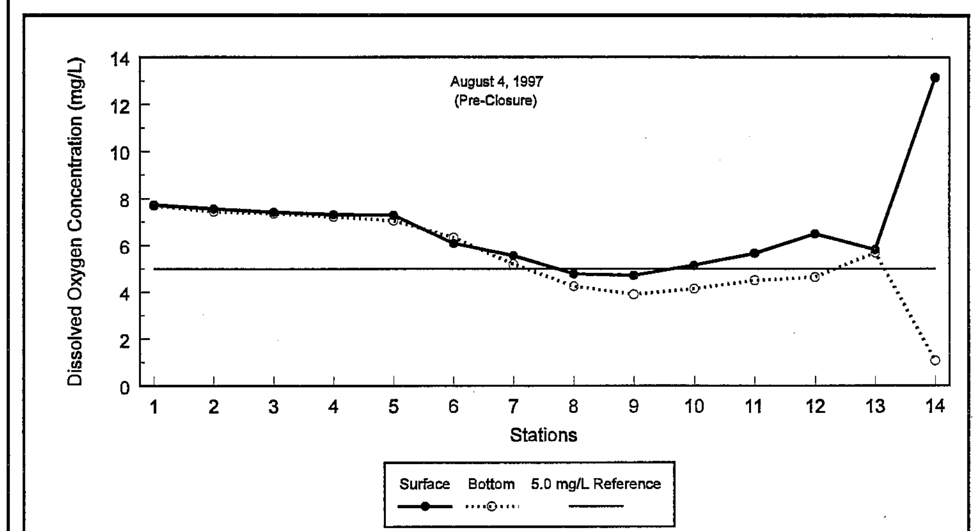

Figure 2
DISSOLVED OXYGEN CONCENTRATIONS IN THE STOCKTON SHIP CHANNEL

The August 4 sampling showed a definite depression (sag) in the eastern channel (Figure 2). Surface and bottom dissolved oxygen levels were relatively high (>7.0 mg/L) in the western portion of the channel from Prisoners Point to Columbus Cut (site 5). Dissolved oxygen decreased east of this region, with bottom levels dropping below 5.0 mg/L from Turner Cut (site 8) to the middle of the Rough and Ready Island area (site 12). Surface levels dropped below 5.0 mg/L in the heart of this area from Turner Cut to Fourteenmile Slough (site 9). Warm water (25-27°C), reduced tidal circulation, and intermittent reverse flows in the San Joaquin River past Stockton appear to have contributed to the low dissolved oxygen levels in the eastern channel. Average daily flow past Stockton was -316 to -446 cfs during the week preceding the run. The return of surface dissolved oxygen levels above 5.0 mg/L in the Rough and Ready Island area (sites 11 to 13) and bottom levels above 5.0 mg/L at site 13 could be partly due to the local influence of San Joaquin River inflow to the ship channel east of Rough and Ready Island. Average daily flow in the San Joaquin River past Vernalis approached 1,900 cfs in July — intermediate between the higher average daily flows of about 2,500 cfs in July 1996 and the lower average daily flow of about 1000 cfs during July in drought years.

The exceptionally high (13.1 mg/L) surface and critically low (1.1 mg/L) bottom dissolved oxygen levels measured in the Stockton Turning Basin (site 14) appear to be the result of localized biological and water quality conditions in the basin. The basin is